

Heat Shield for Extreme Entry Environment Technology (HEEET)

Completed Technology Project (2013 - 2018)



Project Introduction

The objective of HEEET is to advance a dual-layer thermal protection system architecture by addressing the manufacturing capability, design tools, assembly, attachment, and seaming. The technology includes a dense outer mold-line layer constructed from high conductivity carbon fibers designed to handle peak heating and ablation, and a second inner layer consisting of blended carbon and phenolic fibers designed to have a lower thermal conductivity that will efficiently handle the integrated heating of entry. The technical approach allows the thicknesses of each layer to be optimized to meet the specific missions in a robust and mass-efficient manner. The project is working with industry manufactures to assure technology transfer and facilitate sustainable engineering implementation for future NASA missions. The project will demonstrate the capability through the design and build of assembly hardware and production of a 1-meter diameter, flight relevant engineering test unit to validate the quality of the manufacturing and assembly processes and mechanically tested to demonstrate structural capability for a mission-relevant testing.

Anticipated Benefits

HEEET was offered as a new technology to NF-4 missions and it expected to be offered for future Discovery and NF opportunities. HEEET is identified as an enabling technology for future Ice Giant robotic science missions. HEEET is being considered by the MSR formulation team for the Earth Entry Vehicle. HEEET weave has been used for 3D carbon carbon development by the DoD. They seek to use the industry loom infrastructure that was developed by the HEEET project.



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Ames Research Center (ARC)

Responsible Program:

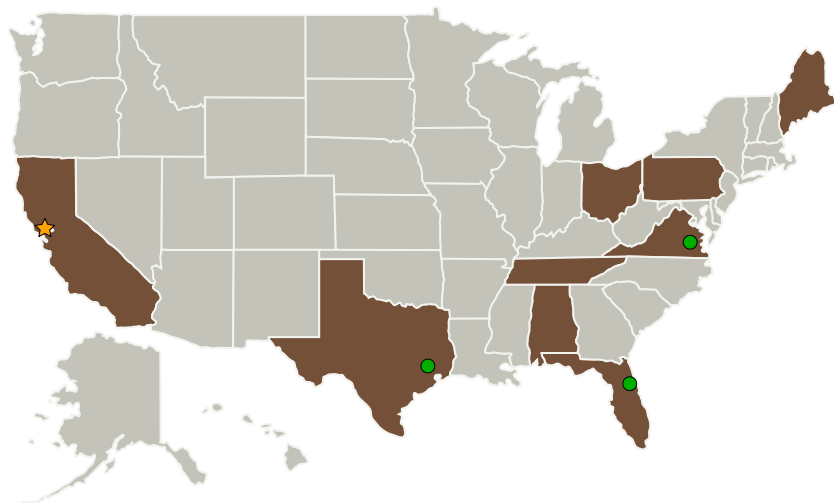
Game Changing Development

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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Ames Research Center(ARC)	Lead Organization	NASA Center	Moffett Field, California
● Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas
● Kennedy Space Center(KSC)	Supporting Organization	NASA Center	Kennedy Space Center, Florida
● Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Project Management

Program Director:

Mary J Werkheiser

Program Manager:

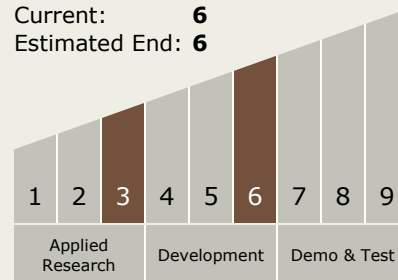
Gary F Meyering

Principal Investigator:

Ethiraj Venkatapathy

Technology Maturity (TRL)

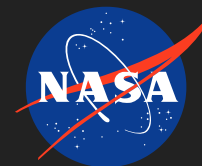
Start: 3
Current: 6
Estimated End: 6



Target Destinations

Mars, Others Inside the Solar System

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Co-Funding Partners	Type	Location
Center Innovation Fund(CIF)	NASA Program	District of Columbia
Jet Propulsion Laboratory(JPL)	NASA Center	Pasadena, California
Planetary Science	NASA Program	
SBIR/STTR	NASA Program	

Primary U.S. Work Locations	
Alabama	California
Florida	Maine
Ohio	Pennsylvania
Tennessee	Texas
Virginia	

Project Transitions

**October 2013:** Project Start**September 2018:** Closed out

Closeout Summary: The technology development goal for the Heatshield for Extreme Entry Environment Technology (HEEET) project were to establish a replacement thermal protection system for heritage carbon-phenolic. The investment satisfies the Agency's need to have a heatshield system capable of handling high enthalpy atmospheric entry missions through a commercially sustainable process. The technology is a dual-layer, tiled-ablator system that takes advantage of advanced three-dimensional textile weaving methods in industry. Ground-based thermal performance tests and experiments demonstrate the thermal protection system will successfully handle a heat flux of 5 kW/cm² at pressure conditions as high as 5 atmospheres. The development effort includes specifications for textile and material processing standards, ablator tile machining and seaming, property database and response models, analysis tools and design data. The HEEET project successfully advanced a new thermal protection system technology to a technology readiness level of 6, and it is now ready to enable science missions to Venus, Saturn, Uranus and Neptune. Planetary Science Division, Exploration Systems Development Division, European Space Agency

Project Website:

https://www.nasa.gov/directorates/spacetech/game_changing_development/index.html